UF Transportation Institute UNIVERSITY of FLORIDA | McTrans

MONTHLY NEWS & UPDATES

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HCM 7th Edition to be Released Soon

The Transportation Research Board has recently made the decision to release the next version of the **Highway Capacity Manual as HCM 7.0**.

The HCM7 will be the first fully electronic release of the HCM since its inaugural release over 70 years ago. In addition to the new electronic format, the HCM7 contains significant additions to its scope:

- Guidance on the application of HCM methods to determine capacity impacts of connected and automated vehicles (CAVs).
- A new network analysis method to evaluate spillback between freeways and urban streets, estimate travel time across facilities, and conduct lane-by-lane analysis for freeways.
- A new two-lane highways analysis method that offers improved analysis of two-lane highway capacity and operational performance.
- Enhancements to existing pedestrian analysis methods at signalized intersections and uncontrolled crossings.
- Significant Errata – The HCM 7th Edition will address all errata and revisions from the HCM 6, including several changes to terminology and methodology that impact multiple chapters.

If you are attending the TRB 2022 Annual Meeting, do not miss the chance to learn firsthand the new features of the HCM 7th Edition, presented by the original researchers and members of the TRB Committee on Highway Capacity and Quality of Service (ACP40): Event Details.

Our team is already working on the implementation of these computational engines into the next release of the Highway Capacity Software (HCS), to be announced soon. Stay tuned for upcoming updates!

Two-Lane Highways Analysis - A Look Ahead at the Upcoming Release of the HCM from a Practitioners' Perspective

Dr. Fabio Sasahara

Two-lane highways are a critical component of the US transportation system, providing connections between rural and urban areas and the Interstate Highway System.

The upcoming release of the Highway Capacity Manual (HCM) will include a new methodological framework to analyze the quality of service of two-lane highways, based on the research project NCHRP 17-65 – Improved Analysis of Two-Lane Highway Capacity and Operational Performance. This project was approved by the TRB Committee on Highway Capacity and Quality of Service (ACP40) in 2019 for inclusion in the HCM. The pre-publication version of the chapter is available for free at hcmvolume4.org.

This article highlights the major changes in the new methodology (2019 methodology) compared to the current method published with the HCM 6th edition (2016 methodology).

New Service Measure – Follower Density

The 2019 methodology introduces a new service measure called Follower Density. It is described as "the number of vehicles in a follower state per mile per lane." In this context, a "follower" vehicle is defined by a headway equal to or less than 2.5s.

Another change to the methodology is the removal of highway classifications (Class I, Class II, and Class III), which would determine the appropriate service measures in the 2016 methodology. With the new methods, Follower Density will always be the service measure for all two-lane highway configurations.

This change overcame issues with the Percent Time Spent Following (PTSF) performance measure in 2016, which couldn't be directly measured in the field.

LOS	Follower Density (followers/mi/ln)	
	Higher-Speed Highways Posted Speed Limit ≥ 50 mi/h	Lower-Speed Highways Posted Speed Limit < 50 mi/h
A	≤ 2.0	≤ 2.5
B	> 2.0 – 4.0	> 2.5 – 5.0
C	> 4.0 – 8.0	> 5.0 – 10.0
D	> 8.0 – 12.0	> 10.0 – 15.0
E	> 12.0	> 15.0
F	Demand exceeds capacity	

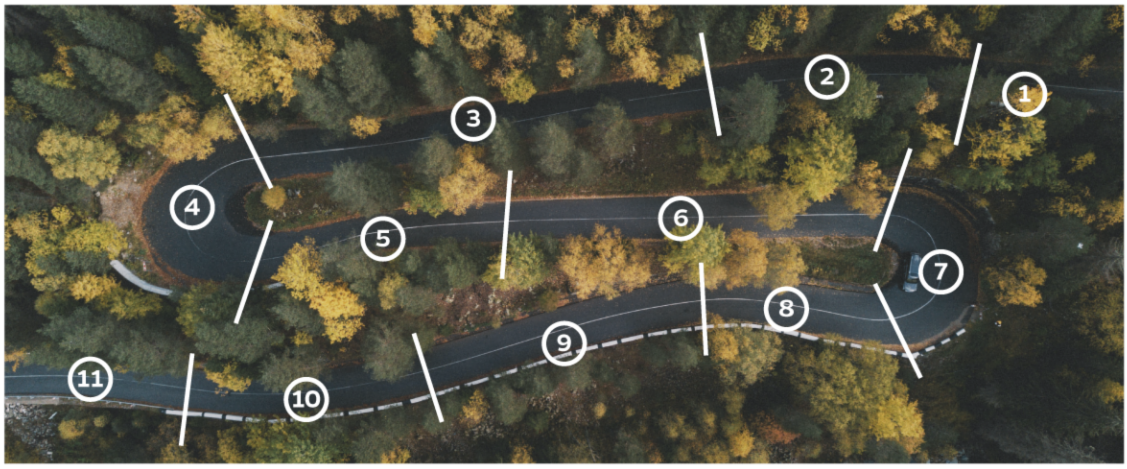
HCM Exhibit 15-6 – New LOS Criteria for Two-Lane Highways

Other performance measures included in the methodology are:

- Average Speed: average spot speed at the endpoint of the segment
- Percent Followers: count of followers vehicles divided by the total number of vehicles

Sensitivity to Horizontal Curvature

The 2019 methodology can now address horizontal curvature elements for more accurate estimations of speed. A segment can be divided into sub-segments, classified as tangent or curve – for the latter, different horizontal curve classification groups are established based on curve radius (ft) and superelevation (%).



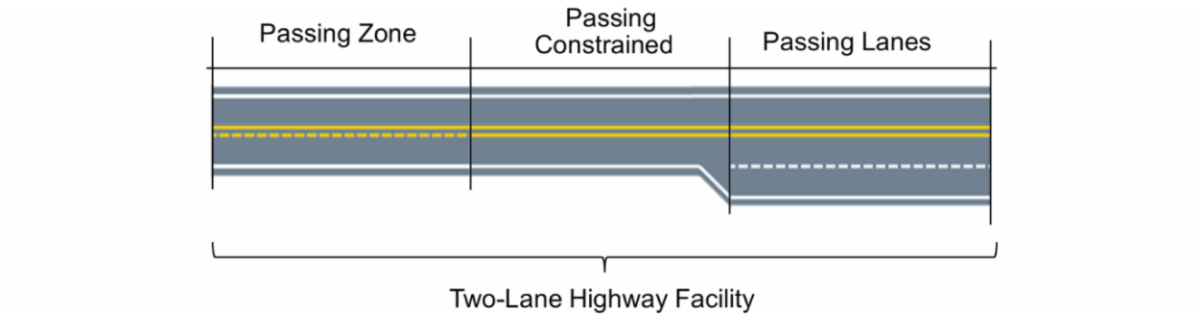
HCM Exhibit 26-23 – Sample Horizontal Curve Inputs

Facility Analysis and Segmentation

The 2019 methodology allows the analysis of three different segment types, which can be aggregated into a facility-level analysis:

- *Passing Zone*: passing is permitted
- *Passing Constrained:* passing is prohibited
- *Passing Lane:* a second lane is added to a given direction of travel, allowing vehicles to pass without going into the opposite direction lane

The 2016 methodology required the user to provide the % of no-passing zones and the length of any passing lanes within the segment as variables instead of directly modeling each segment type.



Two-Lane Highways Segmentation Framework

Free-Flow Speed (FFS) Estimation based on Posted Speed Limit

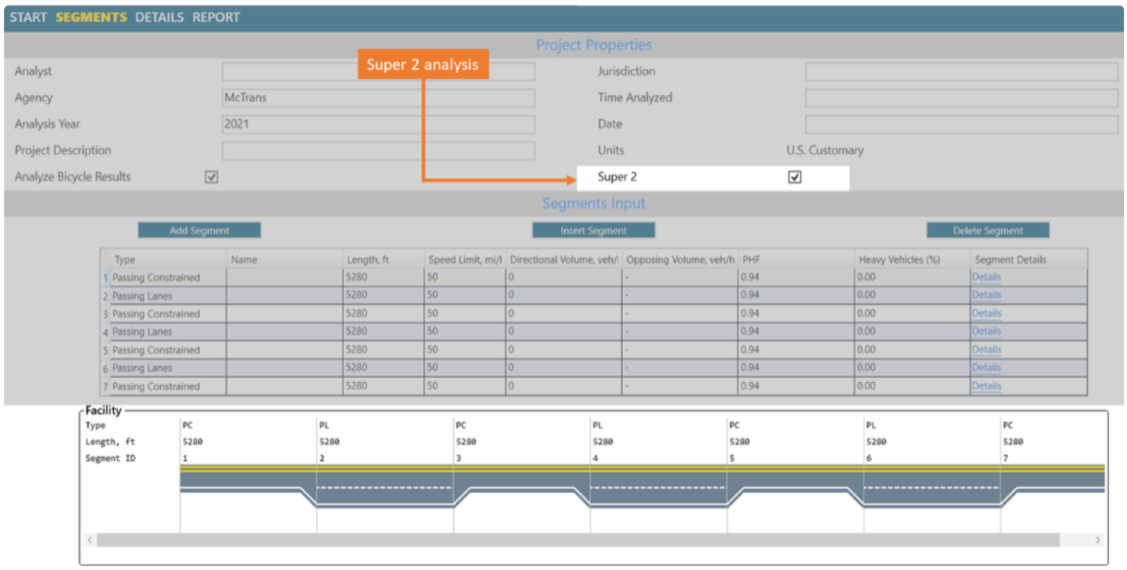
The 2019 methodology redesigned the equations to estimate free-flow speed when field measurements are not available, using the posted speed limit as an input. The previous 2016 methodology relied on an equation where the analyst needed to input a base free-flow speed, with little guidance on estimating such input. The new approach is consistent with other Uninterrupted Flow methods in the HCM (freeways and multilane highways).

Analysis of 2+1 (Super 2) Sections

A Super 2 Highway, also called "2+1 Highway", is a two-lane highway configuration with a continuous three-lane cross-section, with the middle lane being a passing lane that alternates direction. The new 2019 methodology also includes equations to measure the performance of this highway type.

HCS Implementation

The new Two-Lane Highways Methodology is fully implemented in Highway Capacity Software (HCS) and is already available in the current release.



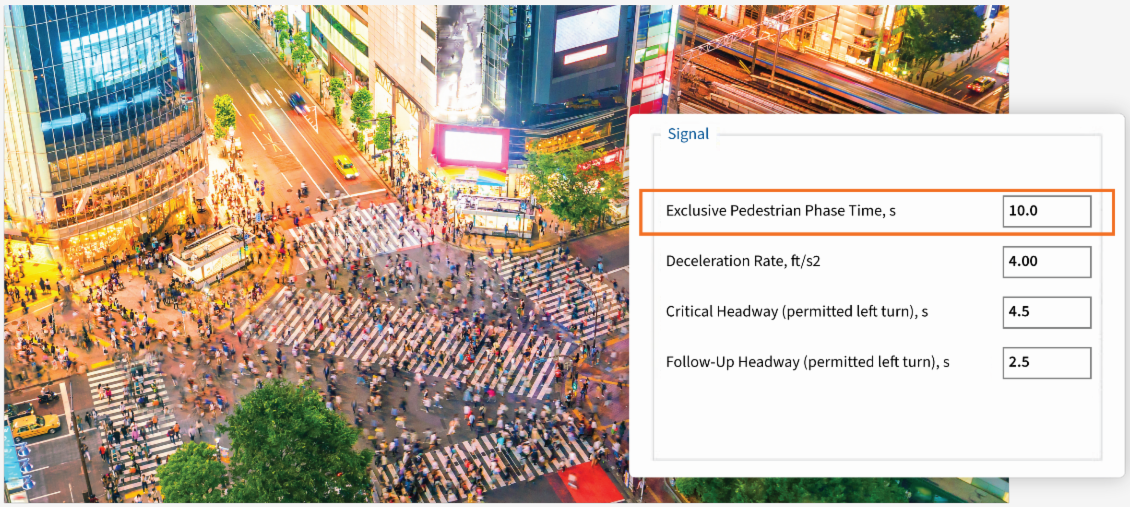
Super 2 Analysis Checkbox in the HCS User Interface

TIPS & HINTS

Exclusive Pedestrian Phase

Exclusive pedestrian phasing is an established safety measure for downtown areas with high pedestrian crossing movement (Read more at FHWA). Also, it may be required for Single-Point Urban Interchange (SPUI) operations. It is activated with the pedestrian phase, such as when a manual call button is pushed, when pedestrians are detected by sensors, or even during low traffic conditions.

Following the HCM6 methodology, HCS7 allows adding an exclusive pedestrian phase to the analysis. The input is found under Detailed Input Data > Signal and is available to the user for uncoordinated intersections. This phase stops motorized vehicle movement from all approaches through their duration. The pedestrian phase duration is added to the total cycle length as red time for vehicles coming from all approaches.



STAFF SPOTLIGHT

Karla Rodrigues-Silva

HSM Subject Matter Expert

I was born and raised in Belo Horizonte, Brazil. I was fascinated by math and science from a young age, which inspired me to pursue a STEM career. The passion for road safety comes from a genuine desire to change people's lives. Transportation touches the lives of every person, and by working in road safety, I realized a vast horizon of unexplored problems, which the proper understanding could make a positive impact for a safer tomorrow.

When I started working at McTrans, I instantly enjoyed the way we worked as a cohesive team. The multicultural environment, along with a multidisciplinary and diverse team, just reminded me that I am in the right place to innovate. My work at McTrans involves various aspects from training to design thinking on Transportation Safety-related products. One of the best parts of my job at Mctrans is the possibility of staying in touch with a professional transportation community. At the same time, I can be part of the link between cutting-edge knowledge and state-of-practice in road safety that converges the various aspects of my career in Brazil. I am glad to learn and work alongside the McTrans team to build technology to support a safer future.

Designing a Weaving Segment with HCS Freeways Tools

Dr. Gustavo de Andrade

The Freeways module in HCS can perform operations and design level analysis for all types of segments. This article describes how can HCS be used to help design a weaving segment for the target level of service (LOS) C. When the “Design Analysis” box option under Project Properties is checked, HCS provides an additional table showing the expected LOS dependent on the number of freeway lanes, helping the analyst design the segment to accommodate the anticipated demand for the target LOS.

For the case of weaving segments, an alternative approach is to design the ramp locations to provide a longer weaving length and facilitate lane-changing from vehicles entering and exiting the freeway. For that analysis, the key variables are the Short Length Geometric input (L_S) and the Max Weaving Length output (L_{MAX}).

L_S, found under Geometric Data inputs, is the distance between the endpoints of any barrier markings (solid white lines) that prohibit or discourage lane changing.

L_{MAX} is an intermediate variable computed by HCS according to the HCM6 methodology as a function of demands and other inputs. It reflects the maximum length where the segment would operate as a weaving.

In the following example, the weaving is designed with LS equal to 1,000 ft. L_{MAX} was calculated as 5.000 ft, and at least four lanes are necessary to meet the LOS C target, as shown on the Design Analysis Table

START WEAVING REPORT

Analyst	
Agency	
Analysis Year	
Project Description	Design of a major weaving segment for a target LOS
Design Analysis	☑
Service Volumes	☐
Number of Lanes	3
Measured FFS	☑
Free Flow Speed, mi/h	75.0
Weaving Configuration	One-Sided
Number of Weaving Lanes (NWL)	2
Short Length (LS), ft	1000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	3000	600	700	600
Peak Hour Factor (PHF)	1.00	1.00	1.00	1.00
Total Trucks, %	0.00	0.00	0.00	0.00
Heavy Vehicle Adjustment Factor (f_{HV})	1.000	1.000	1.000	1.000
Flow Rate (v_i), pc/h	3000	600	700	600
Weaving Flow Rate (v_w), pc/h	1200	Freeway Max Capacity (c_{IFL}), pc/h/ln		2400
Non-Weaving Flow Rate (v_{NW}), pc/h	3700	Density-Based Capacity (c_{IWL}), pc/h/ln		2094
Total Flow Rate (v), pc/h	4900	Demand Flow-Based Capacity (c_{IW}), pc/h		9796
Volume Ratio (VR)	0.245	Weaving Segment Capacity (c_W), veh/h		8376
Minimum Lane Change Rate (L_{CMIN}), lc/h	1200	Adjusted Weaving Area Capacity, pc/h		8376
Maximum Weaving Length (L_{MAX}), ft	5001	Volume-to-Capacity Ratio (v/c)		0.59

Design Analysis Table

Number of Lanes, ln	4	5	6	7
Density, pc/mi/ln	20.5	16.1	13.3	11.4
LOS	C	B	B	B

Design Analysis Inputs and Results for a 1,000 ft long Weaving Segment

If the ramp geometry can be redesigned to increase the length between access points so that $L_S > L_{MAX}$, the segment no longer operates as a Weaving but as a Basic Freeway Segment. HCS automatically compares these values and adjusts the LOS computations accordingly, providing Basic Freeway Segment results and reports case $L_S > L_{MAX}$, including the design analysis table. LS was increased to 5,500 ft in the following example, and only three lanes are necessary to attain LOS c.

Demand and Capacity

Demand Volume veh/h	4900	Heavy Vehicle Adjustment Factor (f_{HV})	1.000
Peak Hour Factor	1.00	Flow Rate (V_p), pc/h/ln	1633
Total Trucks, %	0.00	Capacity (c), pc/h/ln	2400
Single-Unit Trucks (SUT), %	-	Adjusted Capacity (c_{adj}), pc/h/ln	2400
Tractor-Trailers (TT), %	-	Volume-to-Capacity Ratio (v/c)	0.68
Passenger Car Equivalent (E_T)	2.00		

Design Analysis Table

Number of Lanes, ln	2	3	4	5
Density, pc/mi/ln	-	23.1	16.5	13.1
LOS	F	C	B	B

Results for a 5,500 ft long Weaving Segment

Upcoming Training Webinars

Highway Safety Analysis Webinars

8 PDHs are provided for each series

Dec 07 - 08 1 - 5 PM ET

Highway Capacity Analysis Webinars

18 PDHs are provided for each series

Dec 13 - 17 1 - 5 PM ET

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